

Chapter 2

An Integrated Heuristic Approach for the Long-Distance Heterogeneous Vehicle Routing Problem

Mehmet Sevkli

The University of Tulsa, USA

Abdullah S. Karaman

 <https://orcid.org/0000-0001-5768-7382>

American University of the Middle East, Kuwait

Yusuf Ziya Unal

Istanbul Cerrahpaşa University, Turkey

Muheeb Babajide Kotun

Independent Researcher, Nigeria

ABSTRACT

In this chapter, a single depot, long-distance heterogeneous vehicle routing problem is studied with fixed costs and vehicle-dependent routing costs (LD-HVRPFD). The LD-HVRPFD considers retailers far away from the single depot and hence route durations could exceed a day. Thus, the number of available vehicles changes through the course of the multi-day planning horizon. Moreover, it is typical to encounter time-variant demand from retailers. To solve the LD-HVRPFD, the authors developed an iterative heuristic solution methodology integrated into a programming platform. The solution method consists of decomposing the VRP into sequential daily

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problems, model building using macro programming, obtaining a solution using a solver, determining the route-vehicle pairs and time durations, and dynamically updating the truck availability for the next day. The method is illustrated using real data from one of the biggest retail companies in the ready-to-wear sector of textile supply chains. The performance of the heuristic optimization procedure based on time and gap restriction criteria is presented.

INTRODUCTION

Logistics, managing the flow of products/services and information from points of origin to the points of consumption, has become an important functional area of companies due to the advantages it may induce. The benefits it brings are conceivably compelling and numerous including but not limited to a decrease in operational costs, reduction of inventories carried, a decline of time wasted as well as the betterment of storage and transportation of goods; all of these constitute in culminating customer service levels. Logistics management, a subdivision of supply chain management, is concerned with the optimal planning, control, and monitoring of the material/service and information flow both within and across partners of a supply chain.

Finding the optimal route plan for a fleet of vehicles is one of the most encountered problems in logistics in contemporary supply chains extending from private companies to governmental organizations. Better coordination of vehicle routing activity in these supply chains results in significantly decreased operational costs. Dubbed as the well-known vehicle routing problem (VRP), its applications encompass courier delivery services, bus services, mail services, patrol services, maintenance services, unmanned airborne vehicle services, among others. VRP, first introduced by Dantzig and Ramser (1959) as the truck dispatching problem, is a well-known NP-hard combinatorial optimization problem (Lenstra & Rinnooy Kan, 1981).

The VRP aims to find the optimal routes (i.e., minimum distance/time/cost) to be traveled by a fleet of vehicles to several destinations while satisfying the requirements of customers. Through time, the VRP has been extended and the variants now included several of the following constraints (i) load of a truck assigned to a route should not exceed the capacity of the truck; (ii) all routing activity should start and end at the same depot; (iii) deliveries should be made only by one truck in a route; (iv) deliveries should be made before pickups; (v) trucks don't have to return to the depot after deliveries; (vi) a route can contain just delivery customers; (vii) no route should contain pickup customers only; (viii) trucks can visit any of the depots; (ix) total time for a route should not exceed an upper bound; and (x) a customer should be visited within a certain time; inter alia. Accordingly, the route planning is affected

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